REMARKS

The Office Action dated February 17, 2009 has been received and carefully studied.

The Examiner provisionally rejects claims 1-7 on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1, 4-5 and 7-9 of co-pending Application Serial No. 10/593,994. A terminal disclaimer was filed in the co-pending case. It is believed that this renders the instant rejection moot.

The Examiner objects to claims 6-7 under 37 C.F.R. §1.75(c) as being improper multiple dependent claims. By the accompanying amendment, claims 6 and 7 have been amended to correct this informality.

The Examiner rejects claims 1-7 under 35 U.S.C. §103(a) as being anticipated by Hotta et al., JP6092935, in view of Witchey-Lakshmanan (Advanced Drug Delivery Reviews). The Examiner states that Hotta et al. teach N-substituted indole derivatives of formula (I) and their use as an insecticide, and that they can be mixed with a liquid carrier, an emulsifier, a dispersant or a disintegrator among other excipients. Witchey-Lakshmanan is cited for its teaching of the advantage of using shampoos to control fleas and ticks on animals.

The rejection is respectfully traversed.

The claimed invention relates to an agent for <u>controlling acarians parasitic on mammals</u> containing an N-substituted indole derivative of general formula (I).

As demonstrated in Test Examples 1 to 5 of the present specification, <u>the acarian control agent containing the N-substituted indole derivative of the present invention has low insecticidal activity against acarians parasitic on plants</u> (see Test Example 5), but <u>it has control effect and quick-acting properties against acarians parasitic on animals</u> (see Test Examples 1 and 2).

Furthermore, <u>the acarian control agent of the present invention has low toxicity to mammals</u> (see Test Examples 3 and 4).

Thus, the claimed acarian control agent is based on the new findings that the indole derivative has extremely specific and characteristic features, and is an excellent agent for controlling acarians parasitic on mammals.

Hotta et al. describe the use of an N-substituted indole derivative, which is the same as the derivative of the present invention, in the control of noxious organisms in paddy fields, agricultural fields, and the like. However, Hotta et al. specifically describe only that the indole derivatives were effective in controlling nilaparvata lunge-ns belonging to Hemiptera and plutella xylostella belonging to Lepidopters. Thus, these insects such as nilaparvata lunge-ns and plutella xylostella are

noxious organisms in agricultural fields, and are totally different from acarians of the present invention, which are insect pests on companion animals such as dogs and cats.

Therefore, it cannot be easily predicted from the teachings of Hotta et al. that the indole derivative can effectively control acarians with low toxicity against companion animals.

Attached hereto are copies of the following two articles:

Article 1: Watanabe et al., The BCPC Conference: Pests & Diseases 2000, British Crop Protection Council, Farnham, UK, pp 27-32;

Article 2: Morita M et al., The BCPC Conference: Pests & Diseases 2000, British Crop Protection Council, Farnham, UK, pp. 59-66.

The data of Table 2 on page 29 of Article 1 show that an insecticide, ANS-118, exhibits strong biological activity against various insects, whereas ANS-118 does not exhibit the biological activity against acariana, two spotted spider mite.

Also, the data of Table 1 on page 61 of Article 2 show that an insecticide, IKI-220, exhibits strong biological activity against Myzus persicae, which belongs to the order of Homoptera, whereas IKI-220 does not exhibit the biological activity against two spotted spider mite, which belongs to Acarina.

These data indicate that it cannot be easily predicted whether an insecticide effective against insects can also control acarians.

Witchey-Lakshmanan neither teaches nor suggests that the indole derivative of the present invention can effectively control acarians with low toxicity against companion animals.

Accordingly, it is believed that the present invention as claimed is nonobvious over the combination of Hotta et al. and Witchey-Lakshmanan.

Reconsideration and allowance are respectfully requested in view of the foregoing.

Respectfully submitted,

Kevin S. Lemack
Reg. No. 32,579
176 E. Main Street - Suite 5
Westboro, Massachusetts 01581
TEL: (508) 898-1818

Article 1

ANS-118: A Novel Insecticide

M Yanagi, T Watanabe, A Masui
Nippon Kayaku Co., Ltd., 11-2, Fujimi 1-chome, Chiyoda-ku, Tokyo 102-8172, Japan
Nippon Kayaku Co., Ltd., 225-1, Koshikiya, Ageo, Saitama 362-0064, Japan

S Yokoi, Y Tsukamoto, R Ichinose
Sankyo Co., Ltd., 7-12, Ginza, 2-Chome, Chuo-ku, Tokyo 104-8113, Japan
Sankyo Co., Ltd., 1041 Yasu, Yasu-cho, Yasu-gun, Shiga 520-2342, Japan

ABSTRACT

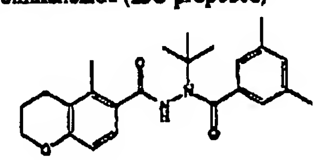
ANS-118 [2'-*tert*-butyl-5-methyl-2'-(3,5-xyloyl) chromane-6-carbohydrazide] is a novel diacylhydrazine insecticide characterized by a methyl-chromane moiety in its structure. Results of greenhouse and field trials have shown this chemical to be effective in controlling various lepidopterous pests (i.e. Tortricidae, Pyralidae, Noctuidae, etc.) on vegetables, tea, fruits, rice, ornamentals, trees and other crops at application rate ranging from 5 to 200 grams active ingredient per hectare. Immediately after treated with ANS-118, lepidopterous larvae stop feeding. This phenomenon can be explained by rapid induction of ecdysis. No phytotoxicity caused by this insecticide has been reported. ANS-118, a novel ecdysone agonist, has large margins of safety to mammalian, avian and aquatic organisms, and has no adverse effects toward non-target arthropods. These properties as well as the high specificity to target insect pests make ANS-118 a suitable tool for the integrated pest management (IPM).

INTRODUCTION

ANS-118 was discovered and developed in a collaboration between Nippon Kayaku Co., Ltd. and Sankyo Co., Ltd. The insecticidal effect of ANS-118 is highly specific to lepidopterous larvae. Products containing ANS-118 are now under world-wide development. This paper reports the chemical and biological properties of ANS-118.

CHEMICAL AND PHYSICAL PROPERTIES

Code number: ANS-118
ISO name: chromafenozide (ISO proposed)
Structural formula:



Chemical name: 2'-*tert*-butyl-5-methyl-2'-(3,5-xyloyl) chromane-6-carbohydrazide

CAS Registry No.:	143807-66-3
Molecular formula:	$C_{24}H_{30}N_2O_3$
Molecular weight:	394.51
Physical state:	White crystalline powder
Melting point:	186.4°C
Vapour pressure:	$\leq 4 \times 10^{\text{[illegible]}}$ Pa (25°C)
Partition coefficient:	$\log P_{ow} = 2.7$ (22°C)
Water solubility:	1.12 mg/L (20°C)
Primary formulations:	5% Suspension concentrate
	0.3% Dust formulation
	5% Emulsifiable concentrate

MAMMALIAN TOXICITY OF TECHNICAL GRADE

Acute oral LD_{50}	Rat (male/female)	> 5000 mg/kg
	Mouse (male/female)	> 5000 mg/kg
Acute dermal LD_{50}	Rabbit (male/female)	> 2000 mg/kg
Acute inhalation LC_{50}	Rat (male/female)	> 4.68 mg/L air
Eye irritation	Rabbit	Slight-irritant
Skin irritation	Rabbit	Non-irritant
Skin sensitisation	Guinea pig	Mild dermal sensitiser
Mutagenicity	Ames test	Negative
	Rec-assay	Negative
	Chromosomal aberration	Negative
Teratogenicity	Rat	Negative
	Rabbit	Negative
Reproduction	Rat	No effect
Carcinogenicity	Rat	Not carcinogenic
	Mouse	Not carcinogenic

EFFECTS ON NON-TARGET ORGANISMS

Carp (*Cyprinus carpio*)	Acute LC_{50} (96hr)	> 47.25 mg/L
Rainbow trout (*Salmo gairdneri*)	Acute LC_{50} (96hr)	> 18.9 mg/L
Daphnia (*Moina macrocopa*)	Acute LC_{50} (3hr)	> 94.5 mg/L
Shrimp (*Neocaridina denticulata*)	Acute LC_{50} (96hr)	> 189 mg/L
Algae (*Selenastrum capricornutum* NIES-35)	NOEC (72 hr)	> 4.76 mg/L
Honeybee (*Apis mellifera* L.)	Acute contact LD_{50} (48 hr)	> 100 µg/bee
	Acute feeding LD_{50} (48 hr)	> 133 µg/bee
Japanese quail (*Coturnix coturnix japonica*)	Acute oral LD_{50} (14d)	> 5000 mg/kg
Earthworm (*Eisenia foetida*) soil	Acute LC_{50} (14d)	> 1000 mg/kg

ANS-118 had no adverse effects toward non-target arthropods such as pollinators, predatory Acarina and Araneida, Hemiptera, Coleoptera, and parasitic Hymenoptera in laboratory (Table1).

Table 1. Beneficial arthropods not affected by chromafenozide at 50ppm

Pollinators/ Beneficials	Scientific name	Beneficials	Scientific name
Pollinator	*Bombus terrestris*	Predatory Hemiptera	*Microvelia horvathi*
	Osmia cornifrons		*Tytthus chinensis*
Predatory Acarina	*Typhlodromus pyri*	Predatory Coleoptera	*Coccinella septempunctata*
	Typhlodromus occidentalis		*Coccinella sp.*
	Zetzellia mali		*Paederus sp.*
	Amblyseius fallacis	Predatory Hymenoptera	*Encarsia formosa*
	Amblyseius cucumeris		*Tricogramma sp.*
	Amblyseius longispinosus	Predatory Araneida	*Lycosa sp.*
		Predatory Neuroptera	*Chrysoperla carnea*

BIOLOGICAL PROPERTIES

Spectrum of Activity

The biological activities of ANS-118 towards a range of pest species expressed as the 50% lethal concentrations (LC_{50}) in laboratory evaluations are shown in Table 2.

Table 2. Biological activities of ANS-118 in laboratory

Arthropod	Scientific name	Common name	Stage*1	Method*2	LC_{50}*3
Lepidoptera	*Spodoptera litura*	Common cutworm	L3	LD	0.4
	Spodoptera exigua	Beet armyworm	L1	LD	0.2
	Plutella xylostella	Diamondback moth	L3	LD	2.5
	Cnaphalocrosis medinalis	Rice leafroller	L3	LD	0.3
	Ostrinia furnacalis	Oriental corn borer	L2	DI	0.2
	Adoxophyes orana	Summer fruit tortrix	L3	LD	0.8
	Heliothis virescens	Tobacco budworm	L1	DI	0.8
Diptera	*Musca domestica*	Housefly	L1	DI	> 200
Coleoptera	*Aulacophora femoralis*	Cucurbit leaf beetle	L1	LD	> 50
Homoptera	*Aphis gossypii*	Cotton aphid	N1	LD	> 200
Thysanoptera	*Thrips palmi*		L1	LD	> 200
Acarina	*Tetranychus urticae*	Two spotted spider mite	N	LD	> 200

*1 L1, 2, 3 and N1 mean the 1st to 3rd instar larval or nymphal stage.
*2 LD: Leaf dipping; DI: Diet incorporation test (mg a.i./kg diet)
*3 LC_{50} values are calculated with larval mortality, at 5 to 6 days after treatment.

Mode of Action

After ingestion by insects, ANS-118 inhibits larval feeding within a few hours and induces a premature lethal moult. This symptom in treated larvae is same as that induced by a

dibenzoylhydrazine (Wing, 1988; Wing et al., 1988). In a reporter gene assay using luciferase as the reporter gene regulated by ecdysteroid response elements, ANS-118 shows a transcriptional activity in the same manner as the ecdysteroid, ponasterone A (Toya et al., 2000). Based on symptoms of the larvae and luciferase induction activity in cell-based assay, it is considered that ANS-118 acts as an ecdysone agonist and induces transcription of genes that regulate moulting, resulting in disruption of normal moulting process.

Field Evaluation

Table 3. Control of the 2nd generation Grape berry moth (*Lobesia botrana* and *Eupoecilia ambiguella*) on grape (Bad Dürkheim, Germany, 1999)

Test material	Dosage (g a.i./ha)	Spray timing* 1	2	3	Number of larvae / 100 grapes
ANS-118 5SC	120	X	X		12.0
	160	X	X		10.7
Methidathion +	640 +		X		46.7
Parathion microencapsulated	320			X	
Untreated	-				120.0

* Spray timing 1, 4 days before the peak day of moth flight; 2, 10 days after the peak day of moth flight; 3, 17 days after the peak day of moth flight; X, treatment

Table 4. Control of *Cydia pomonella* on apple (St. Patern, France, 1997)

Test material	Dosage (g a.i./ha)	% of damaged fruit by Codling moth: Not marketable	Marketable	Total
ANS-118 5SC	50	1.49	1.76	3.25
	75	0.74	1.40	2.14
	100	0.98	1.00	1.98
Tebufenozide 23SC	144	1.12	1.26	2.38
Untreated	–	20.10	5.84	25.94

Table 5. Control of *Spodoptera littoralis* on cotton (Egypt, 1998)

Test material	Dosage (g a.i./ha)	Number of larvae / plant: Pretreatment	3 DAT*	5 DAT*	7 DAT*
ANS-118 5SC	35.7	12.73	3.93	0.95	0.25
	47.6	15.78	4.70	0.67	0.05
Chlorfluazuron 5EC	47.6	15.28	7.50	2.80	0.75
Untreated	–	14.95	11.45	6.85	2.43

* Days after treatment

Table 6. Control of the 2nd generation *Chilo suppressalis* on rice (Yamagata, Japan, 1994)

Test material	Dosage (g a.i./ha)	Hills % of injured	Stems % of injured
ANS-118 0.3% Dust	120	10.0	0.6
Fenthion 2% Dust	800	23.3	1.6
Untreated	–	50.8	7.5

Table 7. Control of tortoricid moths (*Adoxophyes spp.*) on tea (Kumamoto, Japan, 1997)

Test material	Dosage (g a.i./ha)	Number of rolled leaves / m^2
ANS-118 5SC	100	0.49
Methomyl 45WP	600	0.99
Untreated	–	11.42

Table 8. Control of *Anticarsia gemmatalis* on soybean (Brazil, 1998)

Test material	Dosage (g a.i./ha)	Number of larvae per a plot					
		Small larvae (< 1.5 cm)			Large larvae (> 1.5 cm)		
		4 DAT	7 DAT	11 DAT	4 DAT	7 DAT	11 DAT
ANS-118 5SC	12.5	2.5	1.5	2.0	1.2	0.0	0.7
	25	0.4	0.9	3.2	0.4	0.0	0.2
Lufenuron 5EC	15	2.1	0.2	2.8	3.9	0.7	0.9
Untreated	–	13.9*	5.8*	6.9*	39.4*	23.4*	7.6*

Table 9. Control of *Spodoptera exigua* on shallot (Kanchanaburi, Thailand, 1993)

Test material	Dosage (g a.i./ha)	Number of larvae / 10 plants					
		25 Nov	2 Dec	9 Dec	16 Dec	23 Dec	30 Dec
ANS-118 5SC	12.5	7	18	18	9	9	3
	25	1	5	10	3	0	1
	50	6	3	11	0	0	0
Chlorfluazuron 5EC	50	9	5	35	60	45	8
Untreated	–	1	64	51	43	66	43

Treatments were applied immediately after each observation day.

CONCLUSION

Results of extensive field tests demonstrate that formulations of ANS-118 are highly effective on lepidopterous insect pests by foliar spray without causing phytotoxicity to any crops. The fact ANS-118 had no adverse effects toward pollinators and other beneficials

suggests that it may play an important role in IPM programs throughout the world. In Japan, two formulations of ANS-118 (a 0.3% dust formulation and a 5% suspension concentrate) were registered under a trade name MATRIC® in December 1999.

ACKNOWLEDGEMENTS

We would like to express our thanks to our colleagues who have contributed to our understanding of the value of ANS-118 and to the field evaluations of ANS-118 throughout the world.

REFERENCES

Wing K D (1988). RH 5849, a Nonsteroidal Ecdysone Agonist: Effects on a *Drosophila* Cell Line. *Science*, 241, 467-469.

Wing K D; Slawecki R A; Carlson G R (1988). RH-5849, a Nonsteroidal Ecdysone Agonist: Effects on Larval Lepidoptera. *Science* 241, 470-472.

Toya T; Fukasawa H; Masui A; Endo Y; Shudo K (2000). Development of Reporter Gene Assay for Molting Hormone Activities and Evaluation of a Novel Insect Control Agent Chromafenozide. In: *Japan Pesticide Science Society 25th Annual Meeting Abstract*, pp. 60.

Article 2

IKI-220 - A novel systemic aphicide

M Morita, T Ueda, T Yoneda, T Koyanagi, S Murai, N Matsuo
Ishihara Sangyo Kaisha, Ltd. Central Research Institute, 3-1, Nishishibukawa 2-chome Kusatsu, Shiga, Japan

B Stratmann, P Ruelens
ISK Biosciences Europe S.A., ITT tower, 480 avenue Louise, Bte 12, B-1050 Brussels, Belgium

ABSTRACT

IKI-220 is a novel selective systemic aphicide discovered and now under world-wide development by Ishihara Sangyo Kaisha, Ltd. This compound is very active against aphids, and also effective against some other species of sucking insects. IKI-220 rapidly inhibits the feeding behaviour of aphids, and provides long lasting aphid control. IKI-220 shows no cross-resistance with conventional insecticides and exhibits excellent systemic and translaminar activity. In field studies, IKI-220 has exhibited excellent performance for the control of various aphid species in fruits, cereals, potatoes, cotton and vegetables at 50-100 g a.i./ha. In trials on a wide variety of crops IKI-220 has shown no phytotoxicity at rates well in excess of the proposed field use rates. IKI-220 has no negative impact on beneficial insects and mites, and therefore it can be recommended for integrated pest management programs. It has a favourable toxicological, environmental and ecotoxicological profile.

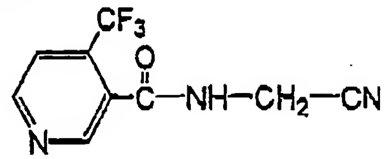
INTRODUCTION

While conducting research on trifluoromethylpyridine derivatives, we discovered that some trifluoromethylnicotinamides were effective in controlling aphids. Out of a large number of synthesised analogues *N*-cyanomethyl-4-trifluoromethylnicotinamide (IKI-220), was selected as a candidate for commercial development, based on its insecticidal activity and its environmental profile. This novel aphicide is being developed as a foliar treatment for use on potatoes, cereals, cotton, pome fruits, stone fruits and vegetables. This is the first report describing the properties and field performance of IKI-220 against some major species of aphid pests.

PHYSICOCHEMICAL PROPERTIES

Code number:	IKI-220
Chemical name (IUPAC):	*N*-cyanomethyl-4-trifluoromethyl-nicotinamide

Structural formula:



Molecular formula:	$C_9H_6F_3N_3O$
Molecular weight:	229.16
Appearance:	White crystalline powder, odourless
Water Solubility:	5.2 g/litre (20°C)
Melting Point:	157.5°C
Vapour pressure:	9.43×10^{-7} Pa (20°C)
Partition coefficient (Log P_{OW}):	0.30
Formulations:	10 WG, 50 WG

PRODUCT SAFETY

Toxicology

Acute oral LD_{50}, Rat male:	884 mg/kg
Rat female:	*1768 mg/kg*
Acute dermal LD_{50}, Rat:	>5000 mg/kg
Acute inhalation LD_{50}, Rat:	>4900 mg/m^3
Eye irritation, Rabbit:	*Non-irritant*
Skin irritation, Rabbit:	Non-irritant
Skin sensitisation, Guinea pig:	*Non-sensitising*
Mutagenicity:	Ames negative

Ecotoxicology

Carp LC_{50} (96hr):	>100 mg/litre
Rainbow trout LC_{50} (96hr):	>91.9 mg/litre
Daphnia magna EC_{50} (48hr):	>100 mg/litre
Algal growth inhibition EC_{50} (72hr):	>91.9 mg/litre

Environmental Fate

Soil degradation DT_{50}:	< 3 days
Predicted ground water concentration:	< 0.1Ug/litre (PELMO modelling)

BIOLOGICAL PROPERTIES

Insecticidal spectrum

IKI-220 is a highly selective aphicide. It does not control coleopteran, lepidopteran, dipteran insects, and mites (Table 1). It is effective against both larval and adult stages of aphids. At the recommended doses under field conditions (50-100 g a.i./ha or 2.5-10 g a.i./100 litres), IKI-220 has been successfully tested against a broad range of aphid species and some other species of sucking insects such as greenhouse whitefly (*Trialeurodes vaporariorum*), yellow tea thrips (*Scirtothrips dorsalis*), tea green leafhopper (*Empoasca onukii*), and brown rice planthopper (*Nilaparvata lugens*).

Mode of action

Table 1. Insecticidal spectrum of IKI-220 under laboratory conditions.

Pest	Stage*	Order	LC_{50} values (mg a.i./litre)
Myzus persicae (green peach aphid)	L2	Homoptera	0.8
Spodoptera litura (common cutworm)	L2	Lepidoptera	>800
Aulacophora femoralis (cucurbit leaf beetle)	A	Coleoptera	>800
Musca domestica (house fly)	L1	Diptera	>800
Tetranychus urticae (two-spotted spider mite)	A	Acarina	>800

* L1, L2: 1st, 2nd larval stage, A: adult stage

The precise biochemical mode of action of IKI-220 is as yet undetermined, but different from any known one. IKI-220 has no action against the classical aphicide targets such as acetylcholine esterase and the nicotinic acetylcholine receptor. Further, spontaneous contractions of the isolated fore-gut of *Locusta migratoria*, enhanced by pymetrozine (Kayser et al., 1994) and a GABA antagonist (personal observation), were unaffected by bath application of IKI-220. From these results, it can be concluded that the target mechanism of IKI-220 is a novel one.

Inhibition of feeding behaviour

A radish leaf infested with first instar larvae of *Myzus persicae* was sprayed with IKI-220 solution. A filter-paper disc stained with a 2 g/litre solution of bromophenol blue in ethanol was placed under the leaf in order to catch the excreted honeydew droplets. Production of honeydew was reduced immediately after treatment. Treated aphids completely stopped feeding within 30 minutes, however they remained on the leaf for 48 hours (Table 2).

Activity against known resistant strains

Leaf dip assays in the laboratory showed that IKI-220 was also highly effective against a field strain of *Aphis gossypii* which had become resistant to organophosphates, carbamates, and pyrethroids (Table 3).

Table 3. Activity of IKI-220 against susceptible and resistant strains of *Aphis gossypii* in leaf-dip assay.

	LC_{90} values (mg a.i./litre)		
Insecticides	Susceptible strain	Resistant strain	TF[a]
IKI-220	0.8	0.8	1
ethiofencarb	5.0	500	100
oxydeprofos	4.5	450	100
permethrin	1.0	>200	>200

Assessments were made 5 days after treatment.

[a] Tolerance factor : LC_{90} of resistant strain / LC_{90} of susceptible strain

Systemic and translaminar effect

Solutions of IKI-220 were injected into the soil around eggplant infested with *Myzus persicae*. IKI-220 showed high activity against this species by soil drench treatment (Table 4).

Table 4. Activity of IKI-220 to *Myzus persicae* on eggplant leaf following soil drench treatment.

Insecticide	LD_{90} value (mg a.i./plant)
IKI-220	0.031
pirimicarb	2
triazamate	0.125
imidacloprid	0.031
pymetrozine	0.5

Assessments were made 5 days after treatment.

Solutions of IKI-220 were deposited on the upper leaf surfaces of eggplants. After drying, caged aphids were placed on each side of leaf surface. IKI-220 exhibited a high translaminar effect, comparable or superior to the standards (Table 5).

Table 5. Mortality of *Myzus persicae* on each side of leaf after treatment of upper leaf surface.

Insecticides	Concentration (mg a.i./litre)	% Mortality upperside	underside
IKI-220	100	100	100
pirimicarb	240	92	42
permethrin	100	74	0
imidacloprid	100	100	100
pymetrozine	100	100	82

Assessments were made 5 days after treatment.

Effects on beneficial arthropods

Based on laboratory results to date, IKI-220 has been safe to a wide range of beneficial arthropods such as *Bombyx mori*, *Apis mellifera*, *Harmonia axyridis*, and *Phytoseiulus persimilis*. Also in field tests no adverse effects have been observed on all the tested beneficial insects and mites such as *Harmonia axyridis*, *Typhlodromus pyri*, *Phytoseiulus persimilis*, and *Apis mellifera*.

FIELD STUDIES

The biological performance of IKI-220 against a broad range of aphid species has also been successfully evaluated under field conditions. The following examples demonstrate the aphicidal effectiveness on important crops.

Peach

Table 8. Control of *Myzus persicae* on peach (France, 1998). *

Insecticide	Dose (g a.i./ha)	% Control, DAT 0	7	15	21	28
untreated		(50.8)	(57.1)	(92.8)	(109.7)	(139.4)
IKI-220	60	(38.1)	95.6	99.4	99.8	99.3
acephate	600	(42.5)	85.3	67.6	58.1	70.3
imidacloprid	50	(38.9)	98.4	98.4	98.7	97.1

Figures in parentheses show the No. of aphids/shoot.
* The chemicals were sprayed on March 30 at a spray volume of 1000 litres/ha.

IKI-220 at 60 g a.i./ha gave outstanding control of *Myzus persicae* up to 28 days after treatment (Table 8), and at the same time prevented the rolling of leaves on the tree. In the

case of acephate and the untreated control leaf rolling was observed (data not shown). The aphicidal activity was comparable to that of imidacloprid, and superior to that of acephate.

Apple

IKI-220 at 70 g a.i./ha showed good activity against *Dysahis plantaginea* up to 28 days after treatment, which was comparable to imidacloprid at 70 g a.i./ha (Table 9).

Table 9. Control of *Dysaphis plantagineo* on apple (France, 1999). *

Insecticide	Dose (g a.i./ha)	% Control, DAT 0	8	15	21	28
untreated		(32.2)	(40.7)	(53.9)	(72.6)	(73.1)
IKI-220	70	(24.1)	40.5	85.3	96.7	87.9
imidacloprid	70	(29.7)	47.9	70.5	91.8	93.1

Figures in parentheses show the No. of aphids/shoot.
* The chemicals were sprayed on April 8 at a spray volume of 1000 litres/ha.

Winter wheat

IKI-220 at 70-80 g a.i./ha initially exhibited a high activity, and good residual activity against aphids infested on ears of winter wheat. The activity was slightly superior to deltamethrin at 6 g a.i./ha (Table 10).

Table 10. Control of *Sitobion avenae* on winter wheat (France, 1998). *

Insecticide	Dose (g a.i./ha)	% Control, DAT 0	2	7	14	21
untreated		(6.2)	(8.6)	(6.4)	(8.1)	(4.0)
IKI-220	70	(5.4)	95.3	97.8	89.7	78.2
	80	(3.9)	95.7	98.0	89.8	83.2
deltamethrin	6	(5.7)	93.2	91.1	85.8	40.6

Figures in parentheses show the No. of aphids/ear.
* The chemicals were sprayed on July 8 at a spray volume of 300 litres/ha.

Potato

IKI-220 at 80g a.i./ha showed an excellent efficacy against field strain of *Aphis nasturtii*, which was resistant to pirimicarb (Table 11).

Table 11. Control of *Aphis nasturtii* on potatoes (France, 1998). *

Insecticide	Dose (g a.i./ha)	% Control, DAT 0	3	7	14
untreated		(22.8)	(15.6)	(11.0)	(13.7)
IKI-220	80	(22.4)	49.7	90.7	94.8
pirimicarb	250	(24.4)	1.5	24.1	23.3

Figures in parentheses show the No. of aphids/plant

* The chemicals were sprayed on Augest 3 at a spray volume of 300 litres/ha.

Crop safety

There are no phytotoxicity concerns for a wide variety of crops such as peaches, apples, winter wheat, potatoes, cotton and tomatoes even at use rates of up to 400 g a.i./ha.

CONCLUSION

IKI-220 is a representative of a new class of aphid control agent, and possesses excellent systemic and rapid anti-feeding activities. It provides excellent and long-lasting control on a broad range of aphids without any phytotoxicity to all crops tested at use rates of 50-100 g a.i./ha. IKI-220 exhibits no cross resistance to other conventional insecticides, and has a high safety to beneficial insects and mites. It also has a favourable toxicological, environmental, and ecotoxicological profile. These characteristics make IKI-220 well-suited for resistant management strategies and integrated pest management programs.

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